

**Objectives** Lead is one of the oldest known toxic metals. For decades, its effects on child development has been remained a topic of concern with an increased interest in 'what prenatal blood lead levels should be considered toxic'. Many recent studies have shown the impacts of increased blood lead on different aspects of infants' development at 'acceptable' levels ( $\leq 100\mu\text{g/L}$ ).

**Methods** To investigate the effects of prenatal lead exposure on children mental development, we have conducted a longitudinal study. Pregnant women ( $n = 364$ ) who referred to hospitals for prenatal care at the first trimester of pregnancy were asked to participate in the survey. Maternal whole blood (MWB) samples, one for each pregnancy trimesters (3 times), and the umbilical cord blood samples, at the time of delivery, were collected and subjected to ICP-MS analysis for measurement of lead concentrations. We invited the mothers and their children to the research hospitals when the children were between 20 and 36 months of age and assessed mental development using Early Child Development Inventory (ECDI). The inventory included 60 items, which cover seven different development areas.

**Results** MWB lead followed a U-shaped pattern over the course of pregnancy with lowest level during the second trimester. The ECDI score was inversely related to the first trimester blood lead concentrations ( $r = -0.15$ ,  $p < 0.05$ ). The logistic regression analysis demonstrated significant relationships between increasing the first trimester lead concentrations ( $\log_e$ ) with low score of ECDI, adjusting for multiple covariates (Unit risk: 5.7, 95% CI: 1.1 - 30.7,  $p < 0.001$ ).

**Conclusions** Increased prenatal lead concentrations, even at "acceptable" level, adversely affects ECDI scores. Therefore, a reappraisal of lead exposure standards for female workers is a critical public health concern.

## 227 CORD BLOOD MERCURY, APOE AND CHILD'S BEHAVIOUR

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**Objective** Mercury (Hg) is recognised as neurotoxin; nevertheless, the effect of prenatal mercury exposure on child behavior in fish eating population is still controversial. The benefit of nutrient element of fish may insufficient to explain it. Apolipoprotein (APOE) is a major protein transporter in brain, epsilon 4 (e4) allele is recognised with poorer neural repair function. We hypothesize that the APOE may modify the effect of prenatal mercury exposure on child behaviour.

**Methods** The present study is a prospective cohort study. There were 166 subjects recruited at delivery and followed up at age of two years. The level of prenatal mercury exposure is determined in cord blood and the genotype of APOE is analysis by the methods Restriction Fragment Length Polymorphism Analysis of PCR-Amplified Fragments (PCR-RFLP). The Child Behavior Checklists version 1.5/5, a parent rating scale, is used to determine the child's behaviour.

**Results** The adverse effect is found in e4 carriers whose cord blood Hg level is greater than  $12\mu\text{g/L}$ . After controlling for the potential confounding factors, the total scale of internalising behavior ( $b = 8.4$ ) and all symptoms of internalising problems is found statistically significant higher in this group. The symptoms and beta coefficients are emotional problem ( $b = 2.6$ ), anxiety/depression ( $b = 2.4$ ), somatic complaints ( $b = 1.68$ ) and

withdrawn ( $b = 1.7$ ). In addition to internalising behaviour, the item of other problem ( $b = 6.7$ ) from externalising behaviour and the total scale of CBCL ( $b = 20.7$ ) are also found statistically significant higher in the group that e4 carriers with greater cord blood Hg.

**Conclusion** APOE gene modifies the effect of prenatal mercury exposure on neurobehaviour. The different frequency of gene susceptible across populations may be a reason of the controversial finding in previous study. The impact of genetic susceptibility should be considered in future study.

## Session: 1. Health impact analysis I

### 228 OTOTOXICITY DUE TO LOW CONCENTRATION EXPOSURE TO SOLVENT MIXTURES IN PAINT FACTORY WORKERS

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**Objective** To evaluate auditory dysfunction in workers exposed to low doses of solvent mixtures.

**Methods** 77 workers exposed to solvents as well as a control group of 84 non-exposed individuals were studied. Fourteen solvents were measured, including toluene, xylene, and n-hexane. Pure tone audiometries were performed at 125 Hz to 8 KHz, as well as brainstem evoked response.

**Results** In the exposed group, subjects' hearing decreased in the measured frequencies, in both ears. Robust multiple linear regression models for frequency means between 125 Hz and 8 KHz, for the left ear  $R^2 = 33.3\%$ , exposed = 4.1 ( $p < 0.001$ ) and for the right ear  $R^2 = 38\%$ , exposed = 4.8 ( $p < 0.001$ ), adjusted by age, chronic pathologies and environmental noise exposure. There was major latency in waves III and V and in intervals I-V and I-III ( $p < 0.05$ ), in both ears, adjusted for age and chronic pathologies.

**Conclusions** It is likely that low exposures to solvent mixtures affect hearing and their central pathways. It is important to elucidate whether this affection could indicate incipient ototoxicity and neurotoxicity.

### 229 HOW WELL ARE WE CONTROLLING FALLS FROM HEIGHT IN CONSTRUCTION EXPERIENCES OF UNION CARPENTERS IN WASHINGTON STATE, USA, 1989-2008

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**Objective** By linking data on union work hours with workers' compensation records, rates of reported work-related injuries resulting from FFH and associated days away from work were evaluated among a large cohort ( $n = 24,830$ ) of union carpenters in Washington State from 1989 to 2008.

**Methods** Using Poisson regression we assessed rates of FFH over the 20-year period while adjusting for temporal trend in work-related injuries that did not involve a FFH. Patterns of paid lost days were assessed with negative binomial regression.

**Results** Crude rates of FFH decreased 82% over the 20-year period in a fairly steady pattern. Reductions were more modest and without demonstrable change since 1996 when considering the temporal reduction in non-FFH injuries. Younger workers

had higher injury rates while older workers lost more days following falls. Rates of paid lost days associated with FFH decreased over time, but there was not a consistent decline in mean lost days per fall.

**Conclusions** Falls from height (FFH) continue to cause significant morbidity and mortality across the construction industry. The observed patterns are consistent with decreased FFH for several years surrounding the Washington Vertical Fall Arrest Standard (1991); the decline exceeds those seen in injury rates overall in this large construction cohort. While crude rates of FFH have continued to decline, they are not as substantial as the declines seen for other types of injuries. The patterns could reflect a variety of things including more global efforts designed to control risk (site planning, safety accountability) and changes in reporting practices.

### 230 A LONGITUDINAL STUDY OF THE OCCUPATIONAL TONER EXPOSURE ON INFLAMMATION AND ALLERGIC BIOMARKERS

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**Objectives** We have been conducting a cohort study since 2003 to examine the health effects caused by exposure to toner. The aim of this study is to evaluate the relationship between toner exposure and biomarkers from the results of a 7-year follow up.

**Methods** The subjects were 1,504 Japanese male workers aged below 50 in 2003. We divided toner-handling works into 5 categories, and then carried out personal exposure measurements on randomly selected workers in each category every year. We also surveyed the toner-handling work category through a self-administered questionnaire every year. Based on the results of the 1<sup>st</sup> personal exposure measurements, toner dust levels were classified into 3 toner-exposed groups: high ( $> = 0.15\text{mg}/\text{m}^3$ ), medium ( $= <0.02\text{mg}/\text{m}^3, 0.15\text{mg}/\text{m}^3<$ ), and low ( $0.02\text{mg}/\text{m}^3<$ ). Individual workers were classified into 3 toner-exposed groups each year based on the measured toner dust levels and toner-handling work category answered in the questionnaire. Workers who were not engaged in toner-handling work were defined as the non-exposed group. We measured C-reactive protein (CRP) and Immunoglobulin E (IgE) in serum and 8-hydroxy-2'-deoxyguanosine (8-OHdG) in urine for biomarkers. Generalised Estimating Equations (GEE) was applied to examine the relationship between toner exposure and the biomarkers. The biomarkers were used as dependent variables and toner-exposed groups, smoking habits, allergic diseases, and age were used as independent variables.

**Results** None of the toner-exposed groups showed significant increases in any of the biomarkers in comparison with the non-exposed group. On the other hand, we found that IgE and 8-OHdG significantly increased in current smokers compared to never smokers.

**Conclusions** This study suggests that the health effects of occupational toner exposure may less than those of smoking, and that the possibility of toner exposure to induce inflammation and allergy is quite low.

### 231 INCREASED CARDIOVASCULAR MORTALITY AFTER METHYL CHLORIDE EXPOSURE

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**Objectives** Methyl chloride leakage from a refrigerator occurred on board an Icelandic fishing vessel in the year 1963. The exposure lasted four days and one man died during the fishing trip. Many of the crew members were hospitalised due to different neurological symptoms and signs, and had not recovered completely several years later. The aims were to study long-term mortality.

**Methods** This is a cohort study with external references. Five referents were randomly selected from registries of seamen and officers matched to each crew member according to age and employment status. Follow up was through record linkage of personal identifier with nationwide mortality registry. Hazard ratios (HR) and 95% confidence intervals (CI) were estimated in Cox proportional hazards model adjusted for age and employment.

**Result** The intoxicated crew eligible for follow up were 20 deckhands and 7 officers, the reference group counted 100 deckhands and 35 officers. Followed up to end of 2010, 14 of the exposed deckhands had died and 6 of the officers versus 49 deckhands and 26 officers among the reference group. The HR for all causes of death was 2.10 (95% CI 1.28–3.46). For all cardiovascular events HR was 2.06 (95% CI 1.02–4.15), for acute coronary heart disease HR was 3.12 (95% CI 1.11–8.78), for cerebrovascular diseases HR was 5.35 (95% CI 1.18–24.35), and for suicide HR was 13.76 (95% CI 1.18–160.07).

**Conclusions** The follow up of the methyl chloride exposed cohort showed increased mortality due to cardiovascular diseases after 47 years. After the intoxication the suicide cases had developed severe depressions that were considered to be related to the exposure. The use of the personal identifiers and the comprehensive population registries strengthen the study. Comparison to non exposed group of the same occupations indirectly control for potential confounders including social class, occupational experience, lifestyle factors, diet, smoking, and alcohol use.

### 232 STRIATAL PATHOLOGY ASSOCIATED WITH CHRONIC MANGANESE EXPOSURE

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**Objective** The purpose of this study was to investigate the neuropathology of chronic Mn exposure in South African Mn miners.

**Methods** We performed a neuropathologic study of eight deceased Mn miners and ten deceased, non-Mn reference miners, none of whom had a diagnosis of a Mn-related clinical syndrome. We compared mean cell density in the caudate, putamen, and globus pallidus interna and externa in Mn miners with non-Mn miners, using GFAP to immunostain astrocytes, CD68 to immunostain microglia, and MAP-2 to immunostain neurons.

**Results** There were no significant differences in age, race or gender between Mn and non-Mn miners. There was a trend toward a higher mean (standard error) pallidal index in the Mn miners